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UTILITY PATENT APPLICATION TRANSMITTAL (Only for new nonprovisional applications under 37 CFR 1.53(b))	Attorney Docket No.	K35A0458	Total Pages	
	First Named Inventor or Application Identifier			
	WALTER W. BUTLER			
	Express Mail Label No.	EJ794464313US		

APPLICATION ELEMENTS See MPEP chapter 600 concerning utility patent application contents.	ADDRESS TO: Assistant Commissioner for Patents Box Patent Application Washington, DC 20231
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<p>1. <input checked="" type="checkbox"/> Fee Transmittal Form (Submit an original, and a duplicate for fee processing)</p> <p>2. <input checked="" type="checkbox"/> Specification [Total Pages <input]<br="" type="text" value="9"/>(preferred arrangement set forth below)</p> <ul style="list-style-type: none">- Descriptive title of the Invention- Cross References to Related Applications- Statement Regarding Fed sponsored R & D- Reference to Microfiche Appendix- Background of the Invention- Brief Summary of the Invention- Brief Description of the Drawings (if filed)- Detailed Description- Claim(s)- Abstract of the Disclosure <p>3. <input checked="" type="checkbox"/> Drawing(s) (35 USC 113) [Total Sheets <input]<br="" type="text" value="4"/>_X_ Formal ___ Informal</p> <p>4. Oath or Declaration [Total Pages <input]<="" p="" type="text" value="2"/><p>a. <input checked="" type="checkbox"/> Newly executed (original or copy)</p><p>b. <input type="checkbox"/> Copy from a prior application (37 CFR 1.63(d)) (for continuation/divisional with Box 17 completed) [Note Box 5 below]</p><p>i. <input type="checkbox"/> DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).</p><p>5. <input type="checkbox"/> Incorporation By Reference (useable if Box 4b is checked) The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.</p></p>	<p>6. <input type="checkbox"/> Microfiche Computer Program (Appendix)</p> <p>7. Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)</p> <p>a. <input type="checkbox"/> Computer Readable Copy</p> <p>b. <input type="checkbox"/> Paper Copy (identical to computer copy)</p> <p>c. <input type="checkbox"/> Statement verifying identity of above copies</p>
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ACCOMPANYING APPLICATION PARTS

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|---|---|---|
| 8. <input checked="" type="checkbox"/> | Assignment Papers (cover sheet & document(s)) | |
| 9. <input type="checkbox"/> | 37 CFR 3.73(b) Statement (when there is an assignee) | <input checked="" type="checkbox"/> Power of Attorney |
| 10. <input type="checkbox"/> | English Translation Document (if applicable) | |
| 11. <input type="checkbox"/> | Information Disclosure Statement (IDS)/PTO-1449 | <input type="checkbox"/> Copies of IDS Citations |
| 12. <input type="checkbox"/> | Preliminary Amendment | |
| 13. <input checked="" type="checkbox"/> | Return Receipt Postcard (MPEP 503) (Should be specifically itemized) | |
| 14. <input type="checkbox"/> | Small Entity Statement filed in prior application, Statement(s) Status still proper and desired | |
| 15. <input type="checkbox"/> | Certified Copy of Priority Document(s) (if foreign priority is claimed) | |
| 16. <input checked="" type="checkbox"/> | Other: Bibliographic Data | |

17. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information:☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No: _____**18. CORRESPONDENCE ADDRESS**☐ Customer Number or Bar Code Label

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or ☒ Correspondence address below

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FEE TRANSMITTAL		Complete if Known	
<i>Note: Effective October 1, 1997. Patent fees are subject to annual revision.</i>		Application Number	UNKNOWN
		Filing Date	HEREWITH
		First Named Inventor	WALTER W. BUTLER
		Group Art Unit	UNKNOWN
		Examiner Name	UNKNOWN
		Attorney Docket Number	K35A0458
TOTAL AMOUNT OF PAYMENT (\$) \$730.00			

METHOD OF PAYMENT (check one)	FEE CALCULATION (continued)																																																																																																																																																																																																								
<p>1. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:</p> <p>Deposit Account Number: 23-1209</p> <p>Deposit Account Name: WESTERN DIGITAL CORPORATION</p> <p><input checked="" type="checkbox"/> Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17 <input type="checkbox"/> Charge the Issue Fee Set in 37 CFR 1.18 at the Mailing of the Notice of Allowance</p> <p>2. <input type="checkbox"/> Payment Enclosed: <input type="checkbox"/> Check <input type="checkbox"/> Money Order <input type="checkbox"/> Other</p>	<p>3. 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SUBMITTED BY			Complete (if applicable)	
Typed or Printed Name	Milad G. Shara, Esq.		Reg. Number	39,367
Signature		Date	9/29/00	Deposit Account User ID

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Application Information

Title Line One :: A DISK DRIVE COMPRISING A COVER SHAPED
Title Line Two:: TO IMPROVE RADIAL AND AXIAL SHROUDING
Total Drawing Sheets:: 4
Formal Drawings :: Yes
Application Type :: Utility
Docket Number :: K35A0458
Licensed - U S Government Agency :: N/A
Contract Number :: N/A
Grant Number :: N/A
Secrecy Order in Parent Application :: N/A

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Registration Number One :: 39,367
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Registration Number Two:: 37,938

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1 moves the HSA on the pivot axis, swinging the actuator 110 arms to move the associated heads
2 114 over the associated disk surfaces.

3 It is desirable to transfer data to and from disks 108 rapidly. The data transfer rate
4 increases with spindle motor rotational speed. However, there are a number of problems
5 associated with higher spindle motor rotational speeds. One problem is increased internal air
6 turbulence in the HDA which can excite disk flutter modes, thereby setting up resonances that
7 can cause the heads 114 to move off track during read and write operations. Proper centerline
8 tracking is imperative for faithfully writing data to, and reading data from, the disks 108.
9 Another problem associated with higher spindle motor rotational speeds is increased windage
10 drag on the disks, thereby causing an increase in spindle motor current and elevated internal
11 HDA temperature. Yet another problem associated with higher spindle motor rotational speeds
12 is an increase in the acoustic noise radiated by the disk drive.

13 Shrouding the disks 108 can reduce internal air turbulence thereby attenuating disk
14 flutter, windage drag, and acoustic noise. The prior art disk drive of FIG. 1 provides radial
15 shrouding by molding the base 106 into a cylindrical form such that the disk 108 fits snugly
16 within, leaving a very narrow gap between the spinning outer perimeter of the disks 108 and the
17 inner surface of base 106. However, the radial shroud of the base 106 cannot extend into the gap
18 118 coextensive with the actuator arms 110 so that the HSA can be inserted into the base 106
19 during manufacture. When inserting the HSA, the actuator arms 110 are rotated such that they fit
20 into the gap 118 without damaging the heads 114. The actuator arms 110 are then rotated to
21 position the heads 114 over the disks 106. The air turbulence which forms in this gap 118
22 exacerbates the disk flutter, windage drag, and acoustic noise.

23 U.S. Patent 5,898,545 to Schirle discloses a separate shroud piece which is inserted into
24 the gap 118 and connected to the base 106 after installing the HSA. The separate shroud piece
25 comprises air flow vanes and cams to facilitate "ramp loading" the heads 114 during spin down.
26 Although the separate shroud piece improves the shrouding over the prior art disk drive 100 of
27 FIG. 1, it must be precisely machined and then precisely mounted into the base 106 in both the

1 axial and radial directions with respect to the disks 108 so as to protrude onto the disks 108 the
2 correct distance. These precision manufacturing constraints increase the complexity and cost of
3 the disk drive.

4 There is, therefore, a need to improve shrouding within a disk drive without incurring the
5 complexity and expense of precisely machining and precisely installing additional components.

6 SUMMARY OF THE INVENTION

7 The present invention may be regarded as a disk drive with improved shrouding,
8 comprising a disk, a spindle motor for rotating the disk, a head, an actuator arm for actuating the
9 head radially over the disk, a base, and a cover attached to the base to form a head disk assembly
10 chamber. The cover comprises an inner surface and an outer surface, and a shroud extending
11 axially from the inner surface into the head disk assembly chamber substantially enveloping the
12 periphery of the disk, including at least part of the periphery coextensive with the actuator arm,
13 to provide radial shrouding of the disk.

14 In one embodiment, the cover further comprises a substantially C-shaped depression
15 positioned substantially concentric over the disk to provide axial shrouding.

16 The present invention may be regarded as a method of manufacturing a disk drive with
17 improved shrouding. A shroud is formed in a cover of a head disk assembly (HDA). A disk, a
18 head, an actuator arm for actuating the head radially over the disk, and a motor for rotating the
19 disk, are disposed into the HDA. The cover is attached to a base of the HDA such that the
20 shroud substantially envelops the periphery of the disk, including at least part of the periphery
21 coextensive with the actuator arm, to provide radial shrouding of the disk.

22 In one embodiment, the method of manufacturing the disk drive further comprises the
23 step of forming a substantially C-shaped depression in the cover, the C-shaped depression
24 positioned substantially concentric over the disk to provide axial shrouding.

25 BRIEF DESCRIPTION OF THE DRAWINGS

26 FIG. 1 shows a prior art disk drive wherein the base of a head disk assembly (HDA) is
27 formed around the periphery of the disk to provide radial shrouding, but does not extend into a

gap which facilitates installing the head stack assembly into the HDA during manufacturing.

FIG. 2 shows a disk drive according to an embodiment of the present invention comprising a head disk assembly (HDA) chamber for housing a head stack assembly and a disk. An HDA cover comprises an inner surface and an outer surface, and a shroud extending axially from the inner surface into the HDA chamber substantially enveloping the periphery of the disk, including at least part of the periphery coextensive with an actuator arm, to provide radial shrouding of the disk.

FIG. 3A shows further details of the shroud integrated with the cover of FIG. 2.

FIG. 3B shows a cover for an HDA according to an alternative embodiment of the present invention, wherein the cover comprises a substantially C-shaped depression positioned substantially concentric over the disk to provide axial shrouding of the disk.

FIG. 4 shows a cover for an HDA according to an alternative embodiment of the present invention comprising an inner layer and an outer layer, wherein the inner layer comprises a substantially C-shaped depression positioned substantially concentric over the disk to provide axial shrouding of the disk.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 2 shows a disk drive 120 according to an embodiment of the present invention comprising a disk 122, a spindle motor for rotating the disk 122, a head 124, an actuator arm 126 for actuating the head 124 radially over the disk 122, a base 128, and a cover 130 attached to the base 128 to form a head disk assembly (HDA) chamber. The cover 130 comprises an inner surface 132 (see FIG. 3A) and an outer surface 134. As shown in FIG. 3A, the cover 130 further comprises a shroud 136 extending axially from the inner surface 132 into the HDA chamber substantially enveloping the periphery of the disk 122, including at least part 138 of the periphery coextensive with the actuator arm 126, to provide radial shrouding of the disk 122.

The shroud 136 may be realized using any suitable means for extending a radial shroud from the inner surface 132 of the cover 130 such that the periphery of the disk 122 is substantially enveloped (including gap 138). In one embodiment, the shroud 136 is a separate

1 piece adhered to the inner surface 132 of the cover 130; for example, the cover may comprises a
2 flat piece of metal and the shroud 136 an injection molded piece of plastic. Alternatively, the
3 cover 130 may be completely form molded including to form mold the shroud 136. With
4 injection or form molding, no additional components are installed during manufacturing to
5 provide shrouding in the gap 138, nor is it necessary to precisely machine any such components,
6 as with the prior art disk drive disclosed in U.S. patent No. 5,898,545 to Schirle.

7 FIG. 3B shows an alternative embodiment of a cover 130a for an HDA which, in addition
8 to the shroud 136, further comprises a substantially C-shaped depression 140 positioned
9 substantially concentric over the disk 122. The C-shaped depression 140 reduces the air volume
10 in the HDA chamber relative to the surface of the disk 122 which provides axial shrouding in
11 addition to the radial shrouding provided by shroud 136. The C-shaped depression 140
12 comprises depression extremities 142 and 144 that are formed in the cover 130a in such an
13 orientation that, when the cover 130a is attached to the base 128, depression extremity 142 lies
14 on one side of the actuator arm 126, and depression extremity 144 lies on the other side of the
15 actuator arm 126. In this way, the depression 140 can be brought closer to disk 122, thereby
16 displacing a larger volume of air while providing a gap to allow the actuator arm 126 to rotate
17 and actuate the head 124 over the surface of the disk 122. As shown in FIG. 4, in one
18 embodiment an outer layer 146 may be adhered to the cover 130a using a visco damping
19 adhesive which attenuates acoustic noise emanating from the disk drive 120. And in yet another
20 embodiment, a damping material (e.g., a metal having a tuned mass or compressed acoustic
21 foam) is placed within the cavity formed by the C-shaped depression 140 and the outer layer 144
22 which further attenuates the acoustic noise.

23 A method of manufacturing a disk drive with improved shrouding according to one
24 embodiment of the present invention comprises the step of forming a shroud 136 extending
25 axially from an inner surface 132 of a cover 130. A head disk assembly (HDA) is disposed into a
26 base 128 of an HDA chamber, wherein the HDA comprises a disk 122, a head 124, an actuator
27 arm 126 for actuating the head 124 radially over disk 122, and a spindle motor for rotating the

1 disk 122. The cover 130 is attached to the base 128 of the HDA chamber such that the shroud
2 136 substantially envelopes the periphery of the disk 122, including at least part 138 of the
3 periphery coextensive with the actuator arm 126, to provide radial shrouding of the disk 122. In
4 one embodiment in which the shroud 136 is a separate piece, the method further comprises the
5 step of adhering the shroud 136 to the inner surface 132 of the cover 130. In another
6 embodiment, the method further comprises the step of form molding the cover 130; wherein the
7 form molded cover 130 comprises the shroud 136. In yet another embodiment, the method
8 further comprises the step of forming a substantially C-shaped depression 140 in the cover 130,
9 the C-shaped depression 140 positioned substantially concentric over the disk 122 to provide
10 axial shrouding.

11 Because the cover 130 is attached to the base 128 of the HDA chamber after placing the
12 actuator arm 126 in gap 138 and rotating the actuator arm 126 to position the head 124 over the
13 disk 122, the shroud 136 integrated with the cover 130 can extend into the gap 138 providing
14 additional shrouding over the prior art disk drive of FIG. 1.

1 **I CLAIM:**

- 1 1. A disk drive with improved shrouding, comprising:
 - 2 (a) a disk;
 - 3 (b) a spindle motor for rotating the disk;
 - 4 (c) a head;
 - 5 (d) an actuator arm for actuating the head radially over the disk;
 - 6 (e) a base; and
 - 7 (f) a cover attached to the base to form a head disk assembly chamber, the cover
 - 8 comprising:
 - 9 an inner surface and an outer surface; and
 - 10 a shroud extending axially from the inner surface into the head disk assembly
 - 11 chamber substantially enveloping the periphery of the disk, including at least part
 - 12 of the periphery coextensive with the actuator arm, to provide radial shrouding of
 - 13 the disk.
- 1 2. The disk drive as recited in claim 1, wherein the shroud is a separate piece adhered to the
- 2 inner surface of the cover.
- 1 3. The disk drive as recited in claim 1, wherein the cover is form molded and the form
- 2 molded cover comprises the shroud.
- 1 4. The disk drive as recited in claim 1, wherein the cover further comprises a substantially
- 2 C-shaped depression positioned substantially concentric over the disk to provide axial
- 3 shrouding.

- 1 5. A method of manufacturing a disk drive with improved shrouding, comprising the steps
2 of:
3 (a) forming a shroud extending axially from an inner surface of a cover;
4 (b) disposing a head disk assembly into a base of a head disk assembly chamber, the head
5 disk assembly comprising a disk, a head, an actuator arm for actuating the head
6 radially over the disk, and a spindle motor for rotating the disk; and
7 (c) attaching the cover to the base of the head disk assembly chamber such that the
8 shroud substantially envelops the periphery of the disk, including at least part of the
9 periphery coextensive with the actuator arm, to provide radial shrouding of the disk.
- 1 6. The method of manufacturing a disk drive as recited in claim 5, wherein the shroud is a
2 separate piece, further comprising the step of adhering the shroud to the inner surface of
3 the cover.
- 1 7. The method of manufacturing a disk drive as recited in claim 5, further comprising the
2 step of form molding the cover, wherein the form molded cover comprises the shroud.
- 1 8. The method of manufacturing a disk drive as recited in claim 5, further comprising the
2 step of forming a substantially C-shaped depression in the cover, the C-shaped depression
3 positioned substantially concentric over the disk to provide axial shrouding.

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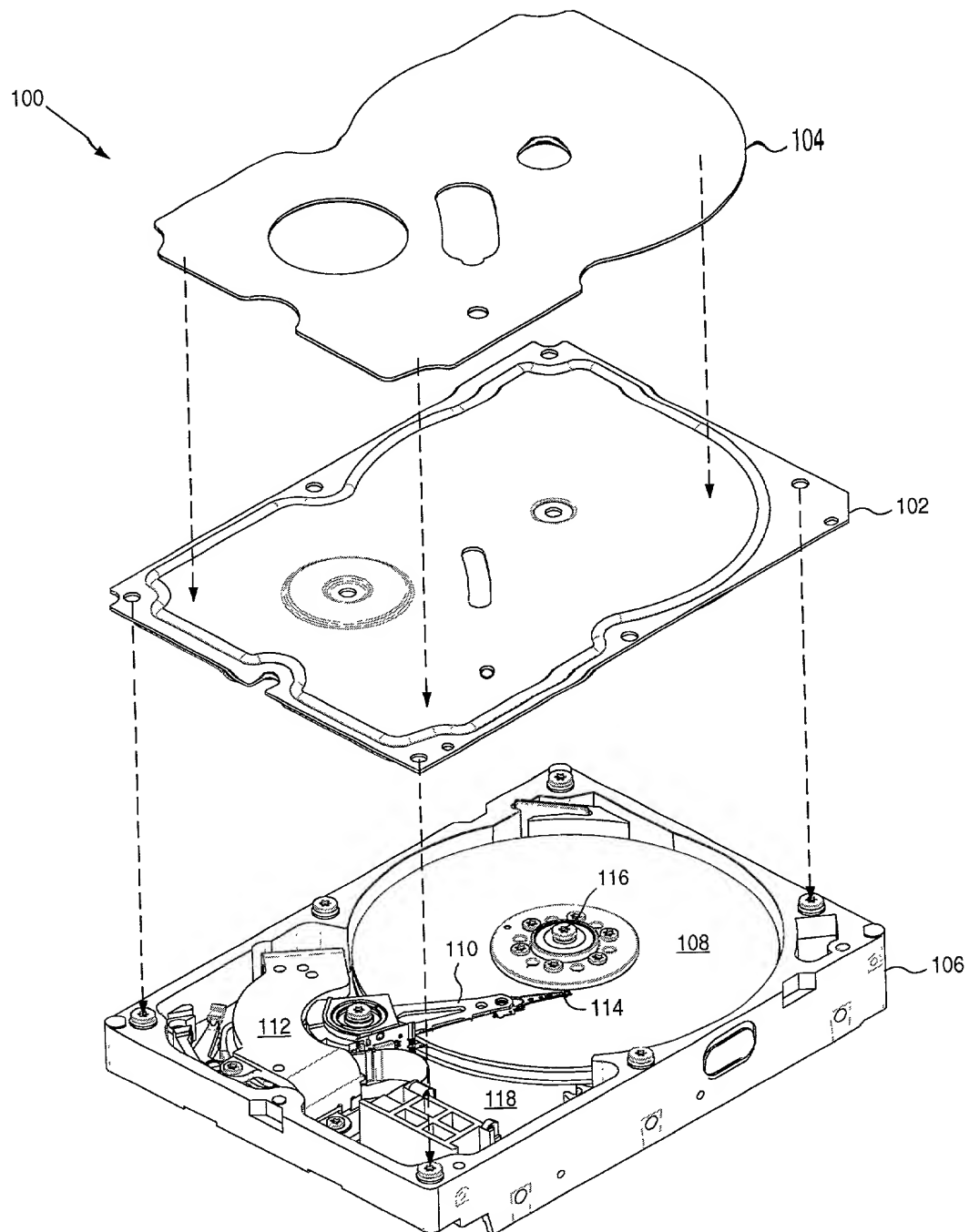


FIG. 1
(Prior Art)

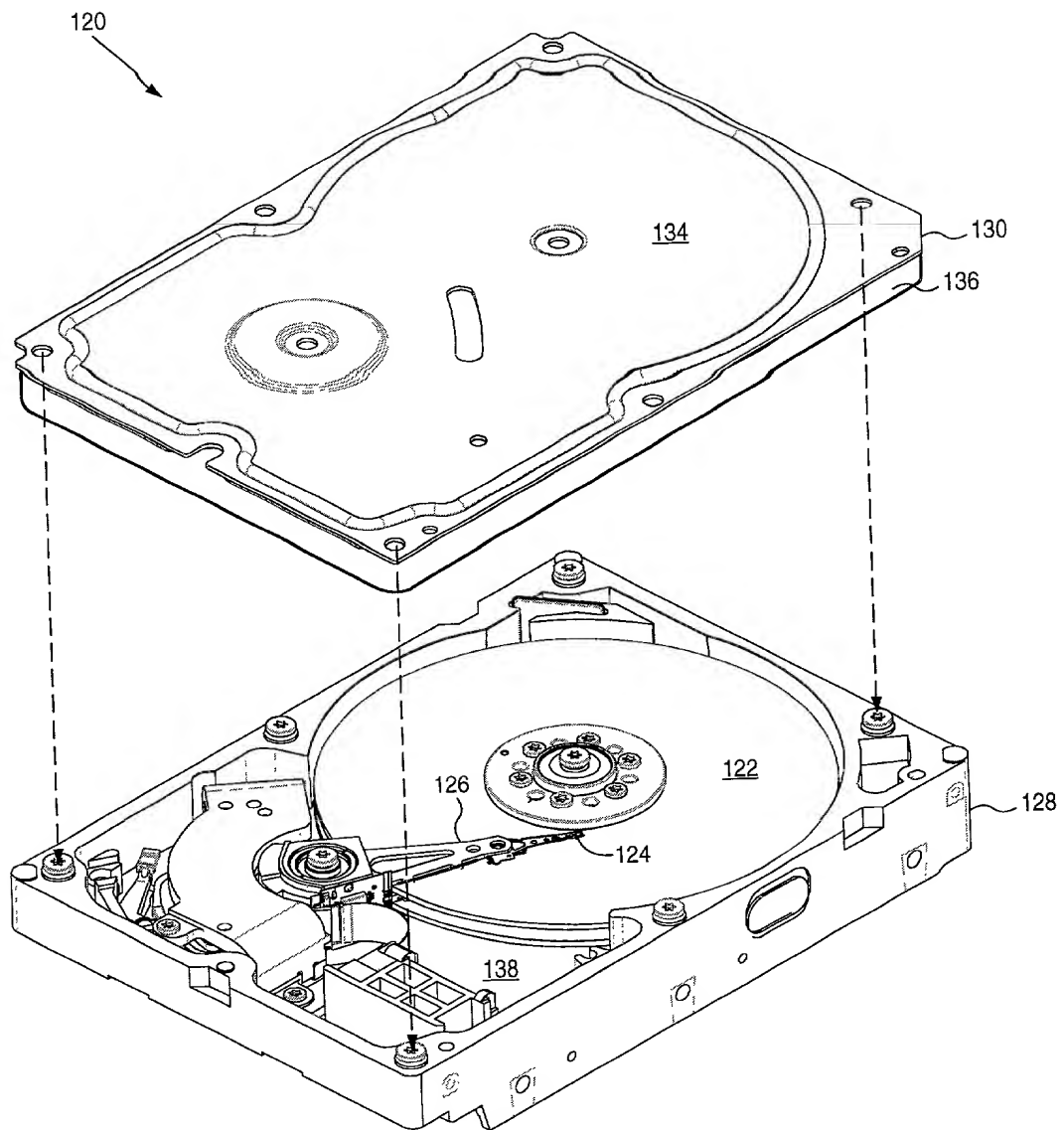


FIG. 2

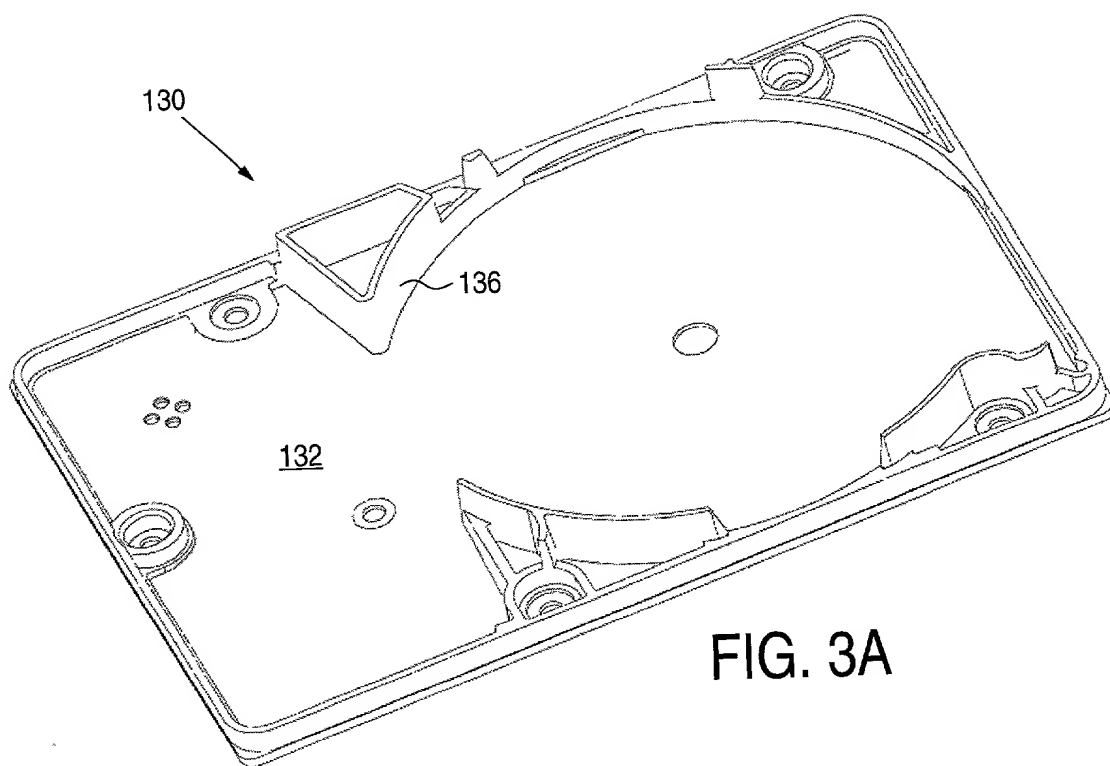


FIG. 3A

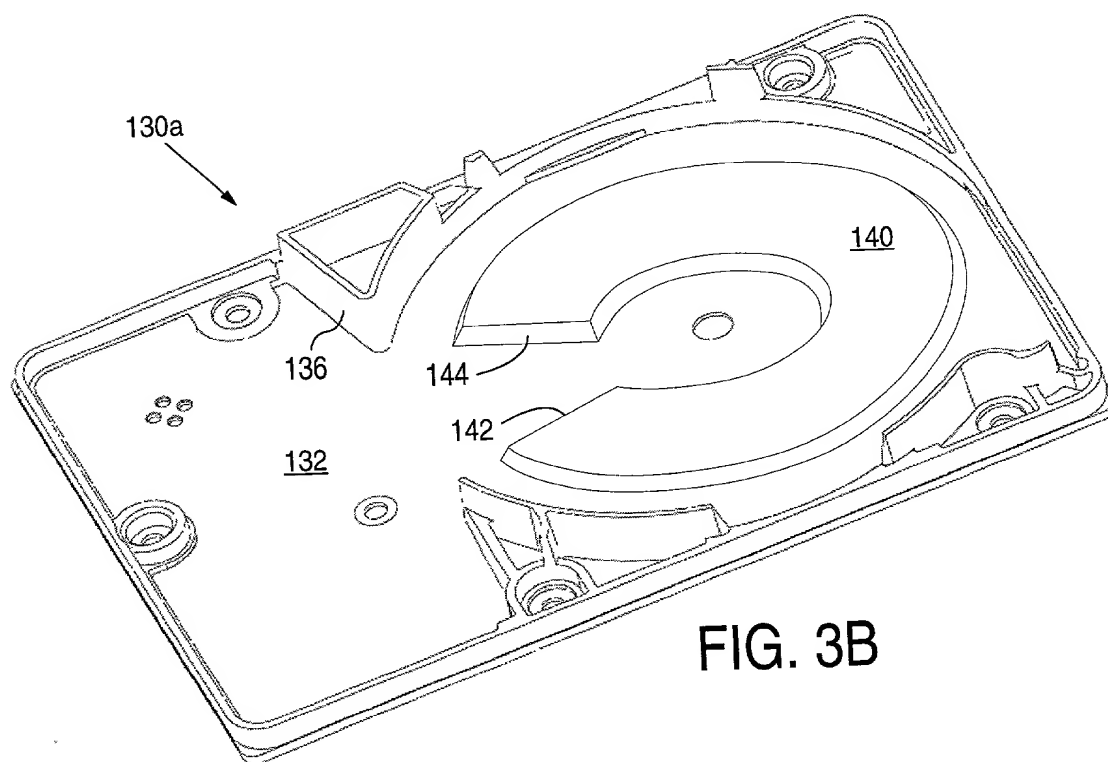


FIG. 3B

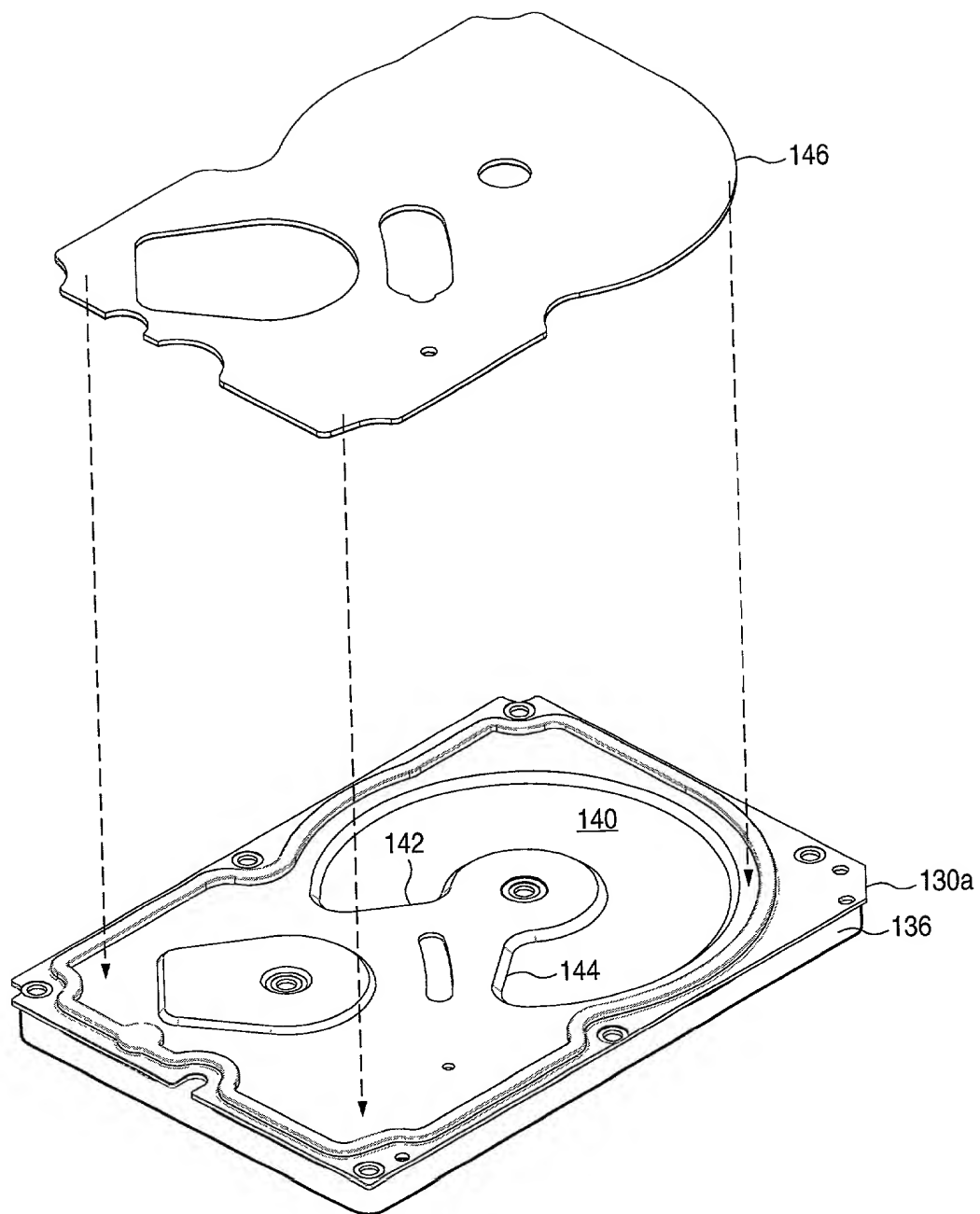


FIG. 4

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PTO/SB/01 (12-97)

Approved for use through 9/30/00. OMB 0651-0032
Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63) <input checked="" type="checkbox"/> Declaration Submitted with Initial Filing OR <input type="checkbox"/> Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)	Attorney Docket Number	K35A0458
	First Named Inventor	WALTER W. BUTLER
	COMPLETE IF KNOWN	
	Application Number	/ Unknown
	Filing Date	Herewith
	Group Art Unit	Unknown
	Examiner Name	Unknown

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

A DISK DRIVE COMPRISING A COVER SHAPED TO IMPROVE RADIAL AND AXIAL SHROUDING

the specification of which (Title of the Invention)

☒ is attached hereto
OR
☐ was filed on (MM/DD/YYYY) [] as United States Application Number or PCT International Application Number [] and was amended on (MM/DD/YYYY) [] (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?	
				YES	NO
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)

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[Page 1 of 2]

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DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith

☐ Customer Number
OR
☒ Registered practitioner(s) name/registration number listed below

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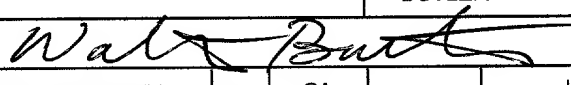
Name	Registration Number	Name	Registration Number
Milad G. Shara	39,367		
Howard H. Sheerin	37,938		

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor:		<input type="checkbox"/> A petition has been filed for this unsigned inventor			
Given Name (first and middle [if any])		Family Name or Surname			
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Inventor's Signature				Date	9/22/00
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Post Office Address	300 HACIENDA DR				
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				Country	USA

☐ Additional inventors are being named on the supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto